# MICOM® Micro4000 DataModem

# User's Manual
## Model M40168

800-1268-1a

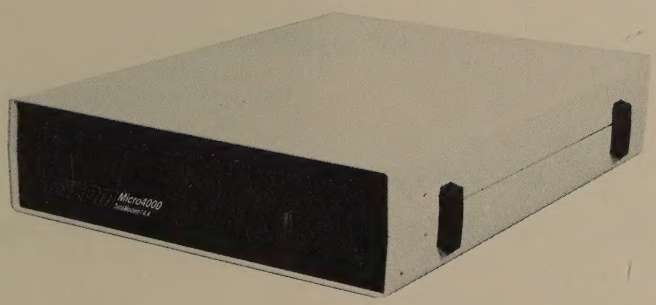
Electronic Services Los Angeles
MI4013X

# Micro4000
# Data Modem

## Model M40168

## User's Manual

**Stock Number 800-1268-1a**




***WARNING***

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with this manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

If radio frequency interference is encountered after installation of the equipment, necessary corrective measures are required to reduce this interference. Information about recommendations for such measures can be obtained from the manufacturer. Contact MICOM Corporate Headquarters for assistance.

**April 1985**

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## THANK YOU FOR CHOOSING THE Micro4000 DATA MODEM

The MICOM Micro4000 Data Modem, a member of MICOM's family of intelligent data communications products, is designed to help you get the most efficient use of your communications lines.

This User's Manual, in turn, is designed to quickly and effectively familiarize you with the functions and operation of the Micro4000 Model M40168. This manual is organized as follows:

- *Section 1, Product Description,* introduces the M40168 modem and describes the application of its operations.
- *Section 2, Do-It-Yourself Installation,* contains procedures for installing and configuring the modem.
- *Section 3, Your Modem's Operating Modes,* describes the functions of the various operating modes for your modem.
- *Section 4, Testing Your Modem,* describes the diagnostics available to you for detecting and isolating faults whenever your modem encounters data transmission problems.
- The *Appendixes* list the technical sepecifications for your modem.

## WARRANTY

MICOM provides a warranty for the Micro4000 Data Modem as described on the Warranty page. Information about equipment repair by MICOM Customer Service is on the Customer Service page.

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(a) MICOM is promptly notified upon discovery that the equipment is defective;

(b) The equipment is returned prepaid to the MICOM plant from which the equipment was shipped; and

(c) MICOM's examination of the equipment shall disclose that any defect was not caused by accident, misuse, neglect, alteration, improper installation, unauthorized repair or improper testing.

MICOM may, in its sole discretion, elect to repair or replace the equipment, in which event MICOM shall have a reasonable time to make repairs or to replace the equipment. MICOM will return the equipment freight prepaid.

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MICOM warrants all repairs or upgrades performed at its factory location or performed by MICOM Customer Service for a period of 90 days after completion.

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*Shipping charges must be prepaid.*

# CONTENTS


| Paragraph | Topic | Page |
|---|---|---|
| | **SECTION 1 — PRODUCT DESCRIPTION** | |
| 1.1 | INTRODUCING THE M40168 | 1-1 |
| 1.2 | YOUR MODEM'S APPLICATIONS | 1-4 |
| | **SECTION 2 — DO-IT-YOURSELF INSTALLATION** | |
| 2.1 | INSTALLATION OVERVIEW | 2-1 |
| 2.2 | SELECTING A LOCATION FOR YOUR MODEM | 2-1 |
| 2.3 | ACCESSING YOUR MODEM'S SWITCHES AND STRAPS | 2-2 |
| 2.4 | SETTING YOUR MODEM'S SWITCHES | 2-3 |
| 2.5 | YOUR MODEM'S STATUS INDICATORS | 2-3 |
| 2.6 | CONNECTING YOUR MODEM | 2-8 |
| 2.7 | YOUR MODEM POWER SUPPLY | 2-9 |
| 2.8 | START UP AND OPERATION CHECK | 2-10 |
| | **SECTION 3 — YOUR MODEM'S OPERATING MODES** | |
| 3.1 | TCM, DYNAMIC DATA RATE MODE | 3-1 |
| 3.2 | TCM, FIXED-RATE MODE | 3-1 |
| 3.3 | CCITT V.29 MODES | 3-2 |
| 3.4 | RETRAIN | 3-2 |
| 3.5 | SIGNAL QUALITY MONITORING | 3-3 |

## CONTENTS (continued)


| Paragraph | Topic | Page |
|---|---|---|
| | **SECTION 4 — TESTING YOUR MODEM** | |
| 4.1 | CONTROL AND TEST SWITCHES | 4-1 |
| 4.2 | FAULT ISOLATION | 4-1 |
| 4.3 | LOCAL MODEM DIGITAL LOOPBACK TEST | 4-4 |
| 4.4 | LOCAL MODEM ANALOG LOOPBACK TEST | 4-5 |
| 4.5 | REMOTE MODEM DIGITAL LOOPBACK AND LINE TEST | 4-6 |
| 4.6 | REMOTE MODEM ANALOG LINE LOOPBACK TEST | 4-7 |
| 4.7 | FULL-DUPLEX LINE TEST | 4-8 |
| | **APPENDIXES** | |
| A | TECHNICAL SPECIFICATIONS | A-1 |
| B | PHYSICAL SPECIFICATIONS | B-1 |
| C | MODEM-TO-DTE CONNECTOR PIN ASSIGNMENTS | C-1 |

# FIGURES


| Paragraph | Topic | Page |
|---|---|---|
| 1-1 | 16-Point, 9600 bps QAM Eye Pattern | 1-1 |
| 1-2 | 64-Point, 14,400 bps QAM Eye Pattern | 1-2 |
| 1-3 | Block Diagram of the TCM Signal Generation | 1-3 |
| 1-4 | 128-Point, 14,400 bps TCM Eye Pattern | 1-3 |
| 1-5 | Typical M40168 Application | 1-4 |
| 2-1 | Dimensions | 2-1 |
| 2-2 | Locations of Switch Groups and Straps | 2-2 |
| 2-3 | Location of Status Indicators | 2-3 |
| 2-4 | Cable Connection Locations | 2-8 |
| 2-5 | Terminal Block Connection to Telephone Line | 2-8 |
| 2-6 | M40168 Power Supply | 2-9 |
| 4-1 | Modem Control and Test Switches | 4-1 |
| 4-2 | Fault Isolation with Remote Operator Available | 4-2 |
| 4-3 | Fault Isolation without Remote Operator Available | 4-3 |
| 4-4 | Local Modem Digital Loopback Data Flow | 4-4 |
| 4-5 | Local Modem Analog Loopback Data Flow | 4-5 |
| 4-6 | Remote Modem Digital Loopback and Line Data Flow | 4-6 |
| 4-7 | Remote Modem Analog Line Loopback Data Flow | 4-7 |
| 4-8 | Full-Duplex Line Data Flow | 4-8 |


# TABLES


| Table | Title | Page |
|---|---|---|
| 2-1 | Switch Group S1 Settings | 2-4 |
| 2-2 | Switch Group S7 Settings | 2-5 |
| 2-3 | Switch Group S8 Settings | 2-6 |
| 2-4 | Modem Status Indicators | 2-7 |

# SECTION 1

# PRODUCT DESCRIPTION

## 1.1 INTRODUCING THE M40168

The M40168 high-speed data modem is a synchronous, 16,800 bits per second (bps), full-duplex, single-channel Data Communications Equipment (DCE). The modem processes serial, synchronous data at a selectable data rate of 16,800, 14,400, 12,000, 9600, or 4800 bps. It conforms to EIA RS-232-C and CCITT V.24 and V.28 interface standards and CCITT V.29 modulation for data transmission at 9600 and 4800 bps. It is designed to operate over type 3002, 4-wire, D1 conditioned, leased telephone lines.

The modem uses a powerful Trellis-Coded Modulation (TCM) technique. TCM is a transmission technique which was devised specifically for the passage of data over a conventional telephone analog circuit at speeds in excess of 9600 bps. Present telephone line technology permits a maximum data signaling rate of 1/2400 of a second or 2400 baud (i.e., the number of times per second some facet of a signal's characteristics can be changed). Conventional 9600 bps quadrature amplitude modulation (QAM) modems encode four bits of data into each baud (2400 baud times 4 bits per baud equals 9600 bps) to produce a 16-point signal constellation or eye pattern (see figure 1-1). When this same conventional QAM technique is applied to a 14,400 bps data stream (i.e., 6 bits per baud), the result is a 64-point eye pattern (see figure 1-2).

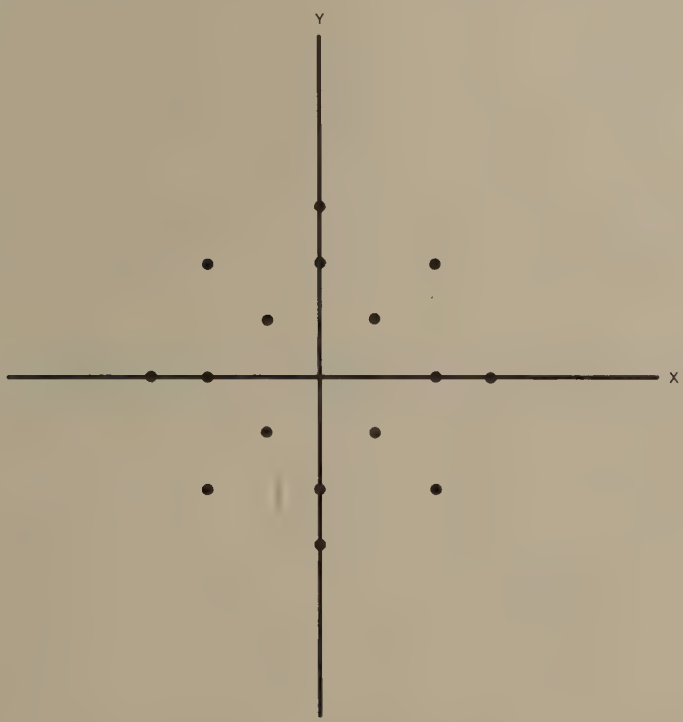



**Figure 1-1. 16-Point, 9600 bps QAM Eye Pattern**

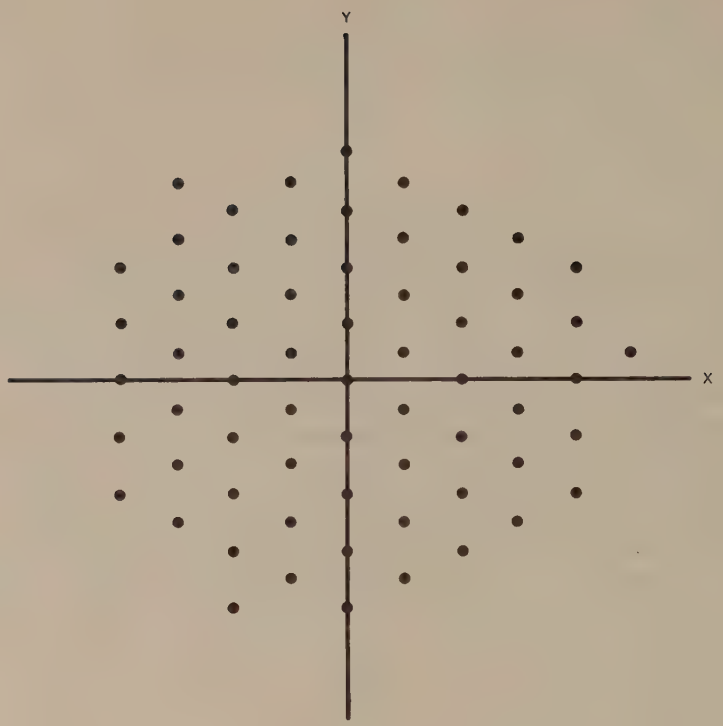



**Figure 1-2. 64-Point, 14,400 bps QAM Eye Pattern**

TCM is an extension of the QAM technology. However, it offers a significant improvement in performance over QAM by providing an error-correcting capability derived from the mathematics used to generate a redundant seventh signal point which is transmitted each baud time (see figure 1-3) to produce a 128-point eye pattern at 14,400 bps (see figure 1-4).

In simplistic terms, because the modem "knew" where the last received data point in the eye pattern was located, and it "knows" the location of the data point currently being received, it can accurately predict the position where the next data point should be received. If, because of some sudden line impairment, that next data point is received in the wrong position, the TCM system makes it possible for the modem to correct the erroneously received data point and continue to pass good data.

It is through the use of this single, derived, redundant data point, that the TCM modem can continuously predict the distance and direction to the next data point expected to be received in the eye pattern. As a result, the M40168 modem can achieve the superior level of performance required to reliably transmit and receive data at 14,400 and 16,800 bps over a voice grade, D1 conditioned, leased telephone circuit.

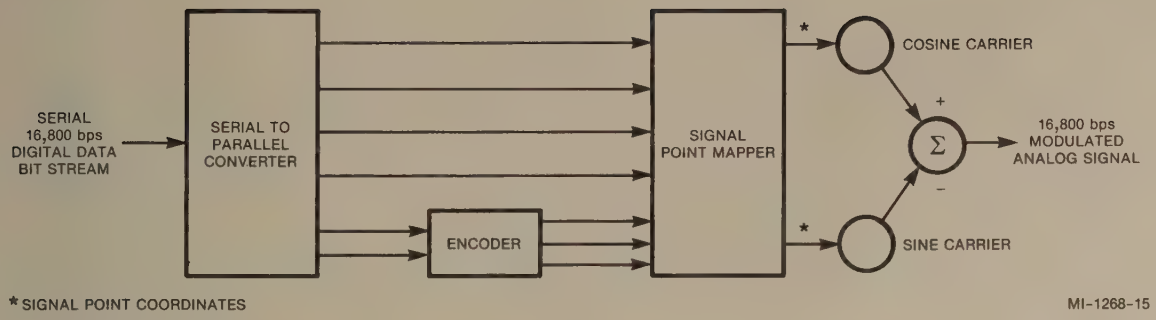



**Figure 1-3. Block Diagram of the TCM Signal Generation**

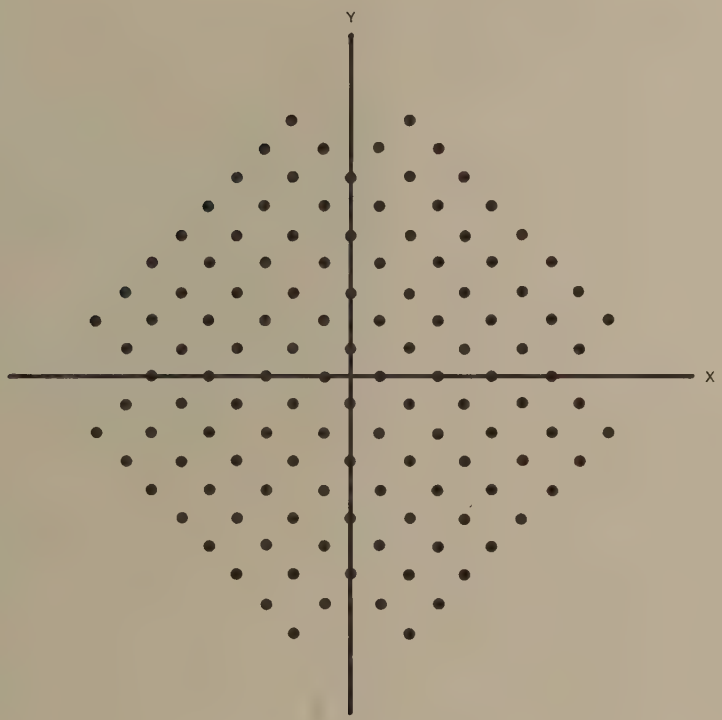



**Figure 1-4. 128-Point, 14,400 bps TCM Eye Pattern**

## 1.2 YOUR MODEM'S APPLICATIONS

There are two basic operating modes for the modem: TCM, and V.29 at various data rates. A fixed-rate TCM is available at manually-selected data rates of 9600 to 16,800 bps. The fallback rate from the higher data rates is 9600 bps. Fixed-rate TCM operation at 16,800 bps is not recommended as a normal operating mode because D1 conditioned line quality usually does not guarantee reliable modem performance at this rate.

In the Dynamic Data Rate mode, the local and remote modems automatically select the highest data rate possible (in the range of 9600 to 16,800 bps, starting at 14,400 bps) for the existing telephone line conditions. In this mode, if the line quality is ideal, the modem will fall forward to 16,800 bps. This mode eliminates the necessity of users having to manually change data rates as the data channel quality varies. Using this mode can greatly increase the data throughput of the modem and is particularly useful in host-to-host and statistically multiplexed data links, where maximum throughput is a major concern.

Also available (switch selectable) is operation per CCITT recommendation V.29 at 9600 bps with fallback to 4800 bps, if required.

See figure 1-5 for a diagram of a typical M40168 application.

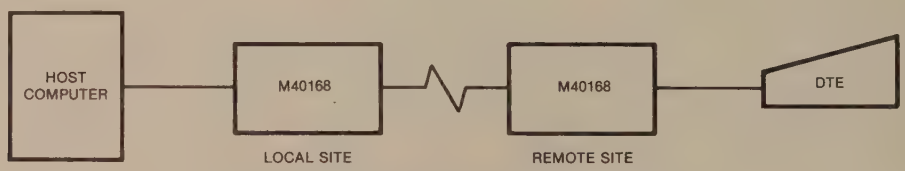



**Figure 1-5. Typical M40168 Application**

# SECTION 2

# DO-IT-YOURSELF INSTALLATION

## 2.1 INSTALLATION OVERVIEW

This overview presents the required steps for Do-It-Yourself Installation. References in each step direct you to a detailed description for the function in that step.

1. Select a location for your modem (refer to paragraph 2.2).
2. Open your modem (refer to paragraph 2.3).
3. Set switches and straps to the desired parameters (refer to paragraph 2.4 and tables 2-1, 2-2, and 2-3).
4. Review the functions of the status indicators (refer to paragraph 2.5).
5. Close the modem (refer to paragraph 2.3).
6. Cable your modem to the required interfaces (refer to paragraph 2.6).
7. Plug the power cable into an outlet, and monitor the status indicators (refer to paragraph 2.8).

## 2.2 SELECTING A LOCATION FOR YOUR MODEM

Locate your modem near your computer or terminal so that the interface cable will reach. Also, locate the modem within six feet of a grounded ac outlet.

**CAUTION:** Do not stack other equipment on top of your modem. Equipment stacked on the modem may bend the cover and possibly damage the components inside.

Provide sufficient space for cover removal, switch access, and unobstructed air flow around your modem. The modem's dimensions are given in figure 2-1. These will aid you in planning your space requirements.

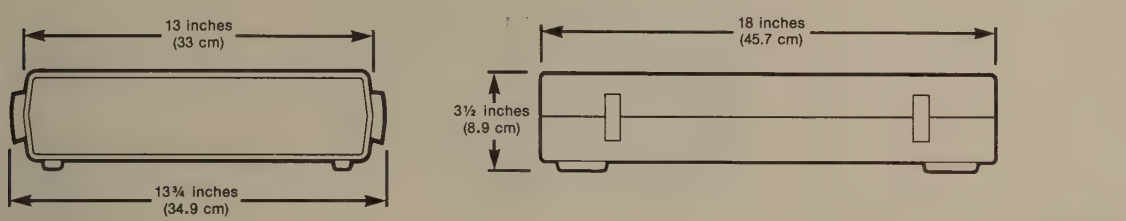



**Figure 2-1. Dimensions**

## 2.3 ACCESSING YOUR MODEM'S SWITCHES AND STRAPS

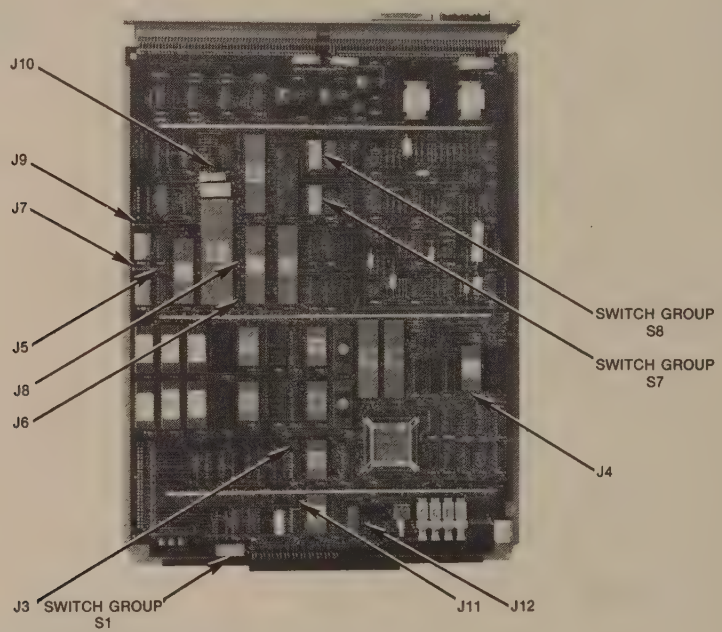
To access the switch groups and straps on your modem, first remove the cover. This is done by unfastening four latches (two on each side), pulling the bottoms of the latches away from the modem's sides, and lifting off the cover.

Switch group S1 is located at the left front of the modem card. It has eight positions labeled 1 through 8. Positions 1 through 4 are the only positions used.

Switch groups S7 and S8 are located at the rear-center of the modem card. These also have eight positions labeled 1 through 8. Switch groups S1, S7, and S8 have the only user-selectable functions on the modem. See figure 2-2 for their locations.

You will find 10 J-designator straps at various locations on the modem card. These straps are factory-set for proper operation of high-speed timing and microprocessor elements on the modem card. The straps must NOT be changed. Figure 2-2 shows the locations and correct positions for replacement of these straps, if they should come loose or be changed by mistake.

To close your modem, replace the cover and close the four latches.




NOTE:
ALL HEADERS ARE PLACED IN POSITIONS 1 AND 2. THESE ARE FACTORY-SET FOR PROPER OPERATION OF HIGH-SPEED TIMING AND MICROPROCESSOR ELEMENTS ON THE MODEM MODULE. THE STRAPS MUST *NOT* BE CHANGED. THE LOCATIONS ARE SHOWN FOR THE PURPOSE OF REPLACEMENT, IF THEY SHOULD COME LOOSE OR CHANGED BY MISTAKE.

MP-1268-02

**Figure 2-2. Locations of Switch Groups and Straps**

## 2.4 SETTING YOUR MODEM'S SWITCHES

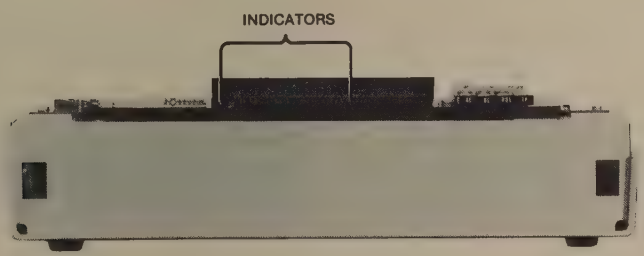
Switch groups S1, S7, and S8 are used to select functions for data transmission operation. Switch group S1 is used to select the operating mode. See table 2-1 for settings on switch group S1.

Switch group S7 is used to select transmit output level, transmit clock source, analog loopback type, and analog loopback gain. See table 2-2 for settings on switch group S7.

Switch group S8 is used to select receive threshold, retrainable carrier control, RTS-to-CTS delay, and DSR status. See table 2-3 for settings on switch group S8.

## 2.5 YOUR MODEM'S STATUS INDICATORS

There are eleven status indicators arranged horizontally across the center of the M40168 modem. These are Light-Emitting Diodes (LEDs) that are visible through the front panel of the modem. From left to right, the first five indicators are the Data Rate indicators: 48 (4800 bps), 96 (9600 bps), 12 (12,000 bps), 14 (14,400 bps), and 16 (16,800 bps). The next six indicators are the Control and Data indicators: **SQ** (Signal Quality), **RD** (Received Data), **CD** (Carrier Detect), **TD** (Transmitted Data), **CS** (Clear-to-Send), and **RS** (Request-to-Send). See figure 2-3 for the location of the status indicators and table 2-4 for a description of indicator functions.




MP-1268-03

**Figure 2-3. Location of Status Indicators**

**Table 2-1. Switch Group S1 Settings**

**NOTE:** Configuration switch groups on your modem may have different designators to indicate the on and off settings. In this manual, ON and OFF are used to designate the following equivalent terms:

ON: Down, Closed
OFF: Up, Open

The normal setting for the S1 switch group is OFF.

| Function | Switch Group S1 Settings | | | | Meaning |
|---|---|---|---|---|---|
| Operating Mode | **1** | **2** | **3** | **4** | |
| | OFF* | OFF | OFF | OFF | Dynamic Data Rate Mode |
| | OFF | OFF | OFF | ON | TCM Mode, 9600 bps |
| | OFF | OFF | ON | OFF | TCM Mode, 16,800 bps |
| | OFF | OFF | ON | ON | TCM Mode, 9600 bps |
| | OFF | ON | OFF | OFF | TCM Mode, 14,400 bps |
| | OFF | ON | OFF | ON | TCM Mode, 9600 bps |
| | OFF | ON | ON | OFF | TCM Mode, 12,000 bps |
| | OFF | ON | ON | ON | TCM Mode, 9600 bps |
| | ON | OFF | OFF | OFF | (Not used) |
| | ON | OFF | OFF | ON | V.29 Mode, 4800 bps |
| | ON | OFF | ON | OFF | V.29 Mode, 9600 bps |
| | ON | OFF | ON | ON | (Not used) |
| | ON | ON | X | X | (Not allowed: X = setting doesn't matter) |
| | **5** | **6** | **7** | **8** | |
| | (Not used; spares) | | | | |

* This modem is designed to operate at 14,400 bps over D1 conditioned, leased telephone lines. If the line quality is ideal, and the modem is operating in the TCM Dynamic Data Rate mode, the modem will fall forward to 16,800 bps. Fixed-rate TCM operation at 16,800 bps is not recommended. The quality of D1 conditioned lines does not guarantee reliable modem performance at a fixed rate of 16,800 bps.

**Table 2-2. Switch Group S7 Settings**

**NOTE:** Configuration switch groups on your modem may have different designators to indicate the on and off settings. In this manual, ON and OFF are used to designate the following equivalent terms:

ON: Down, Closed
OFF: Up, Open

The normal setting for the S7 switch group is OFF.

| Function | Switch Group S7 Settings | | | | Meaning |
|---|---|---|---|---|---|
| Output Level | **1** | **2** | **3** | **4** | (dBm) |
| | OFF* | OFF | OFF | OFF | 0 |
| | ON | OFF | OFF | OFF | −1 |
| | OFF | ON | OFF | OFF | −2 |
| | ON | ON | OFF | OFF | −3 |
| | OFF | OFF | ON | OFF | −4 |
| | ON | OFF | ON | OFF | −5 |
| | OFF | ON | ON | OFF | −6 |
| | ON | ON | ON | OFF | −7 |
| | OFF | OFF | OFF | ON | −8 |
| | ON | OFF | OFF | ON | −9 |
| | OFF | ON | OFF | ON | −10 |
| | ON | ON | OFF | ON | −11 |
| | OFF | OFF | ON | ON | −12 |
| | ON | OFF | ON | ON | −13 |
| | OFF | ON | ON | ON | −14 |
| | ON | ON | ON | ON | −15 |
| Transmit Clock Source | **5** | **6** | | | |
| | OFF* | OFF | | | Internal Clock |
| | OFF | ON | | | Receive Clock |
| | ON | OFF | | | External Clock |
| | ON | ON | | | (Not used) |
| Analog Loopback Type | **7** | | | | |
| | OFF* | | | | Bidirectional |
| | ON | | | | Unidirectional |
| Analog Loop Gain | **8** | | | | |
| | OFF* | | | | +12 dBm |
| | ON | | | | −4 dBm |
| * Factory setting | | | | | |

**Table 2-3. Switch Group S8 Settings**

**NOTE:** Configuration switch groups on your modem may have different designators to indicate the on and off settings. In this manual, ON and OFF are used to designate the following equivalent terms:

ON: Down, Closed
OFF: Up, Open

The normal setting for the S8 switch group is OFF.

| Function | Switch Group S8 Settings | Meaning |
|---|---|---|
| Carrier Detect Threshold | **1** | |
| | OFF* | −26 dBm ON, −31 dBm OFF (with a receiver dynamic range of 0 to −31 dBm) |
| | ON | −43 dBm ON, −48 dBm OFF (with a receiver dynamic range of −10 to −48 dBm) |
| Retrain | **2**** | |
| | OFF* | Enabled |
| | ON | Disabled |
| Carrier Control | **3** | |
| | OFF* | Constant Carrier |
| | ON | Switched Carrier |
| RTS-to-CTS Delay | **4**† | |
| | OFF* | 0 ms |
| | ON | 15 ms |
| DSR Status | **5 6 7** | |
| | OFF OFF OFF | (Not used) |
| | OFF OFF ON | DSR forced ON |
| | OFF* ON ON | DSR OFF in test mode |
| | ON OFF ON | (Not used) |
| | **8** | |
| | (Must be OFF) | |

* Factory setting
** In Constant Carrier modes, switch group S8, position 2 is overridden. The Retrain is always enabled, and retrain occurs when Signal Quality is bad for 3 seconds. Switch group S8, position 2 must be OFF (Enabled) for the Dynamic Data Rate mode to function properly.
† Switch group S8, position 4 is active in Constant Carrier mode only.

**Table 2-4. Modem Status Indicators**

| Status Indicator | ON | OFF | FLASHING |
|---|---|---|---|
| **48**<br>4800 bps | Selected data rate is 4800 bps. | Selected data rate is not 4800 bps. | Indicates test mode on modem. |
| **96**<br>9600 bps | Selected data rate is 9600 bps. | Selected data rate is not 9600 bps. | Indicates test mode on modem. |
| **12**<br>12,000 bps | Selected data rate is 12,000 bps. | Selected data rate is not 12,000 bps. | Indicates test mode on modem. |
| **14**<br>14,400 bps | Selected data rate is 14,400 bps. | Selected data rate is not 14,400 bps. | Indicates test mode on modem. |
| **16**<br>16,800 bps | Selected data rate is 16,800 bps. | Selected data rate is not 16,800 bps. | Indicates test mode on modem. |
| **SQ**<br>Signal Quality | Signal quality is good. Bit error rate is less than 1 error per 10,000 bits. | Signal quality is bad. Bit error rate is more than 1 error per 10,000 bits. | . . . |
| **RD**<br>Received Data | Space has been received. | Mark has been received. | As in data transfer |
| **CD**<br>Carrier Detect | Data carrier signal is present. | No data carrier signal is present from remote modem or telephone line is broken. | Follows test procedures. |
| **TD**<br>Transmitted Data | Space has been transmitted. | Mark has been transmitted. | As in data transfer |
| **CS**<br>Clear-to-Send | Clear-to-Send has been sent. | Clear-to-Send has not been sent. | Modem is retraining. If FLASHING continues, suspect problems and follow test procedure. |
| **RS**<br>Request-to-Send | DTE has data to be transmitted. | DTE has no data to be transmitted and is in idle mode. | . . . |

NOTE: When a Remote Digital Loopback test is in use, the active data rate indicator will BLINK slowly at both the local and remote modems.

## 2.6 CONNECTING YOUR MODEM

You must make the following cable connections to successfully install your M40168 modem:

- Connect the RS-232-C cable from your DTE to your modem (see figure 2-4).
- Connect the telephone line to the four-post terminal block on your modem (see figure 2-5).

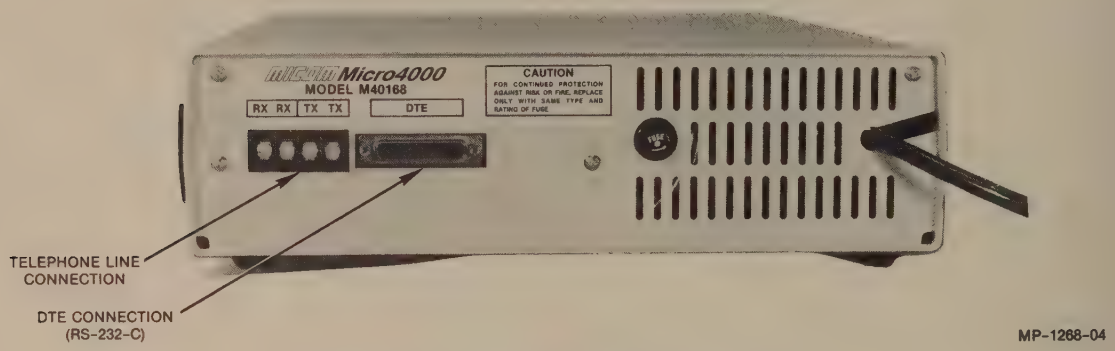



**Figure 2-4. Cable Connection Locations**

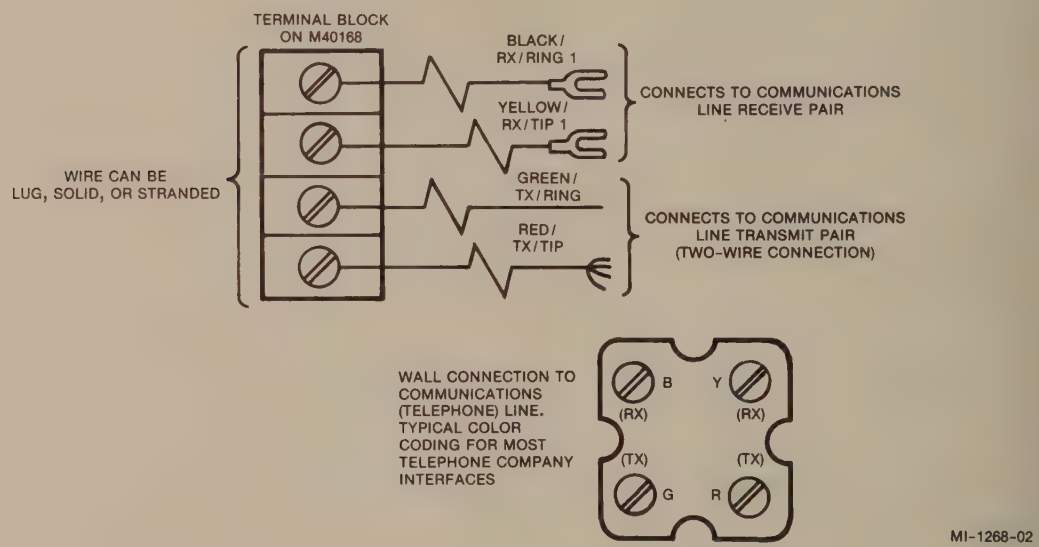



**Figure 2-5. Terminal Block Connection to Telephone Line**

## 2.7 YOUR MODEM POWER SUPPLY

The M40168 modem integral power supply operates at 117 V (see figure 2-6).

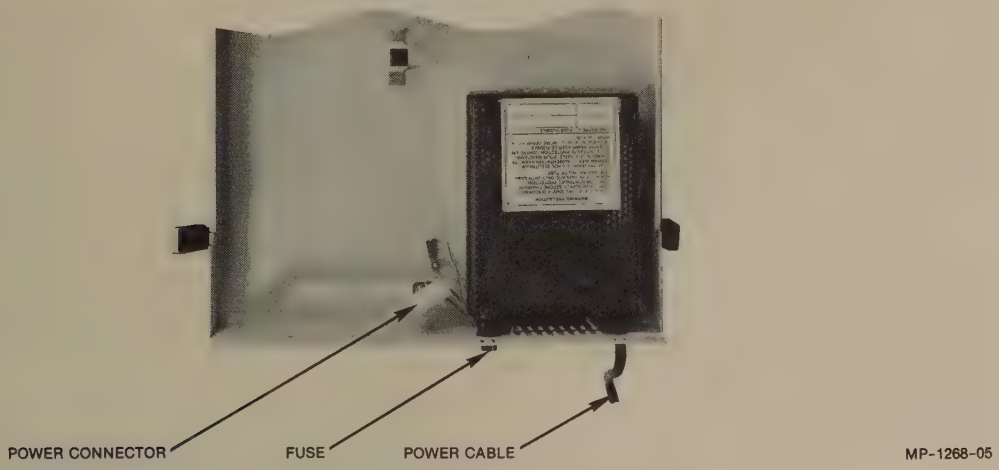



**Figure 2-6. M40168 Power Supply**

## 2.8 START UP AND OPERATION CHECK

Once you have cabled and configured your modem, plug it into a grounded ac outlet. The modem will begin functioning when power is applied.

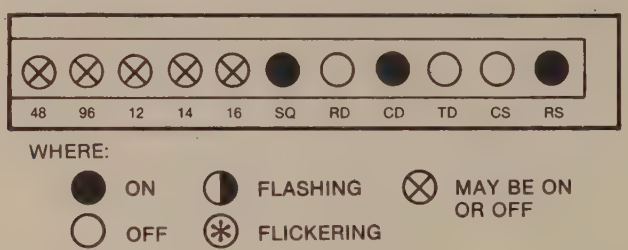
When your modem is powered up, conduct the following local test of the modem:

1. Press the Analog Loopback (AL) test switch. This places the modem in an AL test mode, with transmitter output looped back to the receiver's input.

2. Press the Test Pattern (TP) test switch and monitor the Received Data **(RD)** indicator for 20 seconds. If the **RD** indicator remains OFF for the duration of the test, modem operation is error-free. If **RD** comes ON at any time, the modem is improperly strapped or faulty. If you check the strapping and find it to be correct, replace the modem with a properly-strapped spare and repeat this test.

3. For this test, the normal indications should be as follows:

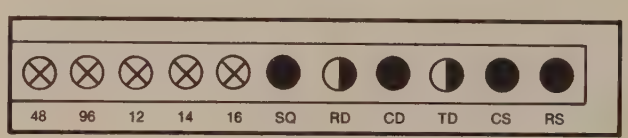
   48, 96, 12, 14, or 16 — ON (depending on selected data rate)




MI-1268-11

The only operating mode for your modem is full-duplex, constant carrier. In a normal operating mode, your modem will display the following:

48, 96, 12, 14, or 16 — ON (depending on selected data rate)




MI-1268-12

# SECTION 3

# YOUR MODEM'S OPERATING MODES

## 3.1 TCM, DYNAMIC DATA RATE MODE

When the Trellis-Coded Modulation (TCM) Dynamic Data Rate mode is in use, the local and remote modems automatically select the highest data rate that provides the best data throughput. If Signal Quality at either modem is poor for at least one minute, that modem will initiate a fallback to the next lower rate. It will then inform the other modem, via in-band signaling, of the rate change. The in-band signaling is specially coded so normal data will not erroneously trigger a rate change. There is no master modem in this operating mode; either modem can initiate, or respond to, rate change signaling.

During in-band signaling, CTS is held off, CD will remain on, and RD will be forced to a steady Mark. The maximum duration of the in-band signaling, during a rate change, is less than twice the RTS-to-CTS delay for the mode and data rate in use. If power is interrupted to a modem, that modem will interrogate the other, when power returns, to determine the other's data rate. Both modems will then come up on-line at the lower data rate of the two. In the data mode, the modems continuously monitor the received data quality. When, during 15 consecutive minutes, the Signal Quality is good enough at one modem for operation at a higher speed, that modem will signal the other of its intention to switch to a higher data rate. If the second modem also agrees, both will then switch to the next higher data rate. In-band signaling is always used for transmission of rate change information.

## 3.2 TCM, FIXED-RATE MODE

Trellis Coding forms the transmitted data into bit combinations that make up a uniquely-coded transmit signal constellation or eye pattern. This improves the ability of the receiver to make accurate decisions on received, distorted signal points. The overall result is far better received data quality than would otherwise occur for a given amount of telephone line distortion.

In TCM, Fixed-Rate operation, a normal data rate of 16,800, 14,400, 12,000, or 9600 bps is manually selected. If the bit error rate becomes excessive, the fallback to a lower speed, where the error rate is acceptably low, can be selected manually.

## 3.3 CCITT V.29 MODES

The M40168 modem allows synchronous modem operation over leased lines at 9600 or 4800 bps in accordance with recommendation V.29 of the Consultative Committee on International Telephony and Telegraphy (CCITT). It provides the following functions:

- The transmitter amplitude and phase modulates a 1700 Hz carrier.
- The primary transmitted data rate is 9600 bps, sent at 4 bits per baud.
- The line spectrum occupied by the transmitted signal is 2400 Hz wide and centered on the 1700 Hz carrier (500 to 2900 Hz).
- The receiver has an automatic adaptive equalizer with a 16-point eye pattern at 9600 bps, and four points at 4800 bps.
- Training time is 253 milliseconds, which is also the RTS-to-CTS delay time.
- An on condition for Carrier Detect occurs when the received line signal level is above −26 dBm.
- An off condition for Carrier Detect occurs at levels below −31 dBm.
- The modem meets RS-232-C and V.24/V.28 digital interface requirements.

## 3.4 RETRAIN

After power-up, Carrier Detect **(CD)** comes ON during the initial training period, and remains ON in any later training mode. Training is followed by a two-second "blind" time, which both ensures that the modem's training is completed, and prevents any repetition of the training mode at that time. Blind time occurs at the end of every training mode, regardless of what caused the modems to retrain. After a successful training period, both modems come up in the data mode, ready for data transmission and reception.

In normal operation, the modems will retrain when any of the following events occur:

- A carrier loss, followed by return of carrier, after more than a 10-second outage.
- Pressing the Analog Loopback (AL) test switch to enter a test mode, and release of AL to return to the data mode.
- Detecting a training signal from the remote modem.
- When the modems automatically change their data rate in the Dynamic Data Rate mode.
- An increase in the received Bit Error Rate (BER) to more than one error per 1000 bits will cause a Retrain. In Constant Carrier operating modes, Retrain is always enabled, and switch group S8, position 2 is overridden.

## 3.5 SIGNAL QUALITY MONITORING

A modem receiver has no indication of the message content in data it processes. Therefore, it cannot directly identify error bits in the received data. Instead, the receiver generates a Signal Quality (SQ) output which indirectly relates to the average BER. This is accomplished by comparing the equalized received signal point outputs to known, undistorted signal point values and taking the difference as the error. By averaging the error values over a period of time, the receiver obtains a digital number which represents SQ. The smaller the number, the better the quality; and vice versa.

The modem's SQ driver circuit has an error threshold equivalent to one error per 10,000 bits. When the SQ number is below this threshold, the **SQ** indicator will be ON indicating Good Data. When the error is greater than the threshold, **SQ** goes OFF indicating Bad Data. If the error signal remains above one error per 1000 bits, and switch group S8, position 2 is OFF or the modem is in a Constant Carrier mode, a Retrain will be initiated in an attempt to correct the large BER. If the high error rate is due to a loss of synchronism between the modems, the retrain will correct the problem. However, if it is caused by continuous, high-level line distortion, or line distortions which the equalizer is not designed to handle, the problem is not correctable by a retrain.

# SECTION 4

# TESTING YOUR MODEM

## 4.1 CONTROL AND TEST SWITCHES

The modem's Control and Test switches consist of the four pushbutton switches at the right front of the modem together with switch groups S7 and S8 (see figure 4-1). The switch, designated S2 at the left of the four test switches, is a Reset switch for the microprocessor. There is no requirement for the use of this switch in normal modem operation.

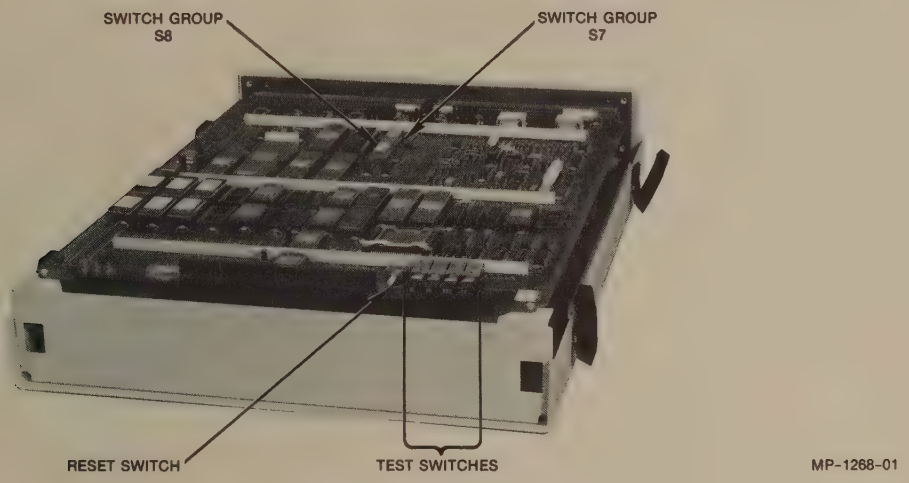



**Figure 4-1. Modem Control and Test Switches**

The test switches, from left to right, are Analog Loopback (AL), Digital Loopback (DL), Remote Digital Loopback (RL), and Test Pattern (TP). Switch group S7, position 7 operates with the AL switch to provide a unidirectional or bidirectional loopback in the transmit and receive analog circuits of the modem. Switch group S7, position 8 provides a Line Loopback Gain of +12 or −4 dB when a bidirectional analog loopback is used.

When a test switch is pressed, the active Data Rate indicator will BLINK slowly to indicate that a test mode exists. With RL in use, the active Data Rate indicator will BLINK at both the local and remote modems. The four main test switches are latching types: press to activate; press again to release.

## 4.2 FAULT ISOLATION

Two flowcharts (figures 4-2 and 4-3) are provided to aid you in determining the nature of any communications problems you may encounter. The flowchart in figure 4-2 shows the procedure used with the aid of the remote operator. Figure 4-3 shows the procedure used without the aid of the remote operator. The diagnostic tests are described in paragraphs 4.3 through 4.7.

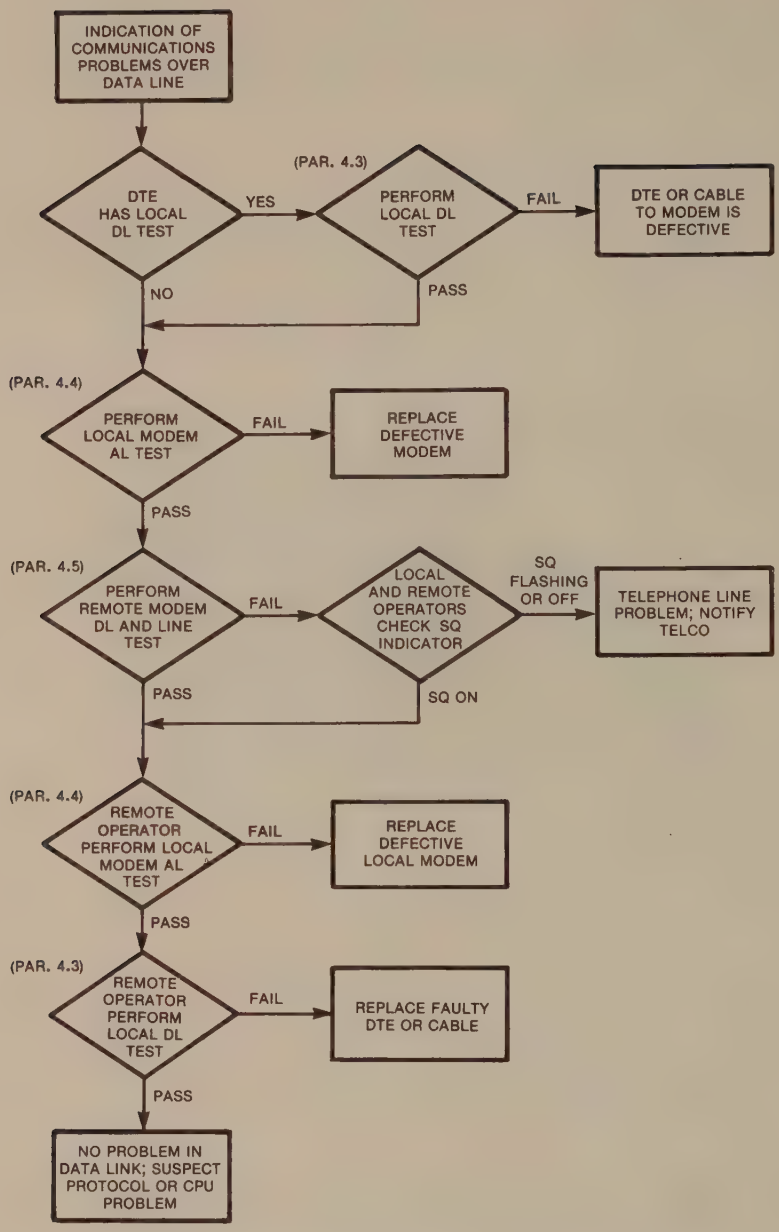



**Figure 4-2. Fault Isolation with Remote Operator Available**

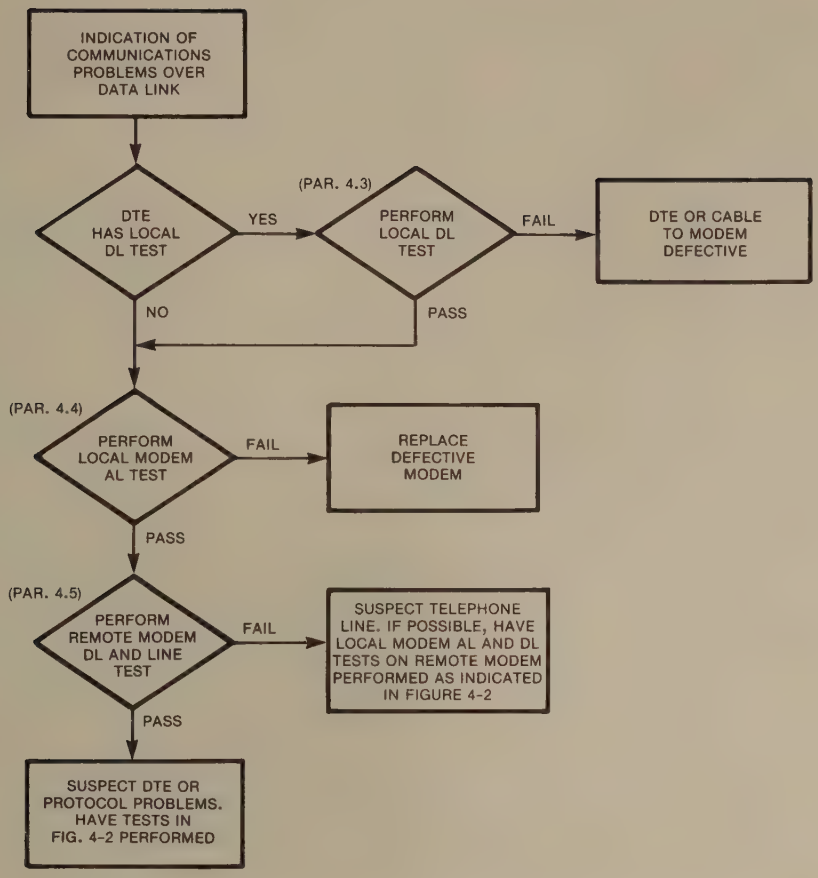

INDICATION OF COMMUNICATIONS PROBLEMS OVER DATA LINK
DTE HAS LOCAL DL TEST
YES
(PAR. 4.3)
PERFORM LOCAL DL TEST
FAIL
DTE OR CABLE TO MODEM DEFECTIVE
NO
PASS
(PAR. 4.4)
PERFORM LOCAL MODEM AL TEST
FAIL
REPLACE DEFECTIVE MODEM
PASS
(PAR. 4.5)
PERFORM REMOTE MODEM DL AND LINE TEST
FAIL
SUSPECT TELEPHONE LINE. IF POSSIBLE, HAVE LOCAL MODEM AL AND DL TESTS ON REMOTE MODEM PERFORMED AS INDICATED IN FIGURE 4-2
PASS
SUSPECT DTE OR PROTOCOL PROBLEMS. HAVE TESTS IN FIG. 4-2 PERFORMED
MI-1268-09

**Figure 4-3. Fault Isolation without Remote Operator Available**

## 4.3 LOCAL MODEM DIGITAL LOOPBACK TEST

To start this test:

1. Press the DL switch until it engages. This commands the local modem to loop data back to the data terminal equipment (DTE). See figure 4-4.

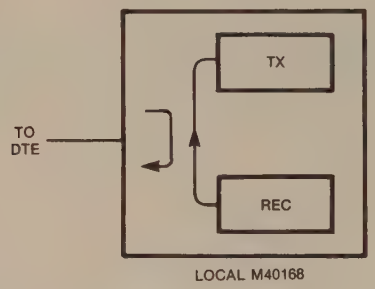
2. If the DTE equipment is capable of sending test data, this procedure, if successful, will prove the integrity of the DTE and the RS-232-C cable. If not successful, test the DTE and its RS-232-C.

3. See figure 4-2 or 4-3 and continue testing.

To end this test:

1. Release the DL switch.

See figure 4-4 for the digital loopback data flow.




MI-1268-05

**Figure 4-4. Local Modem Digital Loopback Data Flow**

## 4.4 LOCAL MODEM ANALOG LOOPBACK TEST

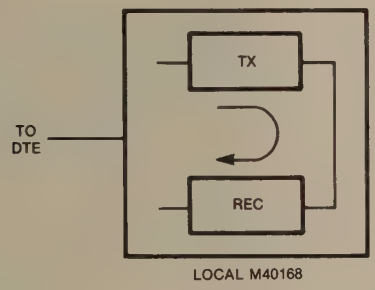
To start this test:

1. Press the AL switch until it engages. This commands the local modem into the analog loopback mode.
2. Press the TP switch.
3. Observe the **RD** indicator. If **RD** is FLASHING, errors are being received and the modem in test is defective; if **RD** is OFF, the operation is error-free. Continue testing.
4. Request the operator at the remote modem to perform this same test.

To end this test:

1. Release the AL switch.
2. Release the TP switch.

See figure 4-5 for the analog loopback data flow.




MI-1268-03

**Figure 4-5. Local Modem Analog Loopback Data Flow**

## 4.5 REMOTE MODEM DIGITAL LOOPBACK AND LINE TEST

To start this test:

1. Press the RL switch on the local modem until it engages. This commands the remote modem to loop the digital interface back to the local modem.

**NOTE:** This test may also be initiated by the remote operator pressing the DL switch on the remote modem.

2. Press the TP switch on the local modem.

3. Observe the **RD** indicator. If **RD** is FLASHING, errors are being received; if **RD** is OFF, the operation is error-free.

   If this test is unsuccessful and the previous local DL test and the remote AL test were successful, there is a high probability that the remote modem is defective.

   If so, contact the remote modem operator and have a local AL test performed to verify the integrity of the remote modem.

To end this test:

1. Release the RL switch.
2. Release the TP switch.

See figure 4-6 for the digital loopback data flow.

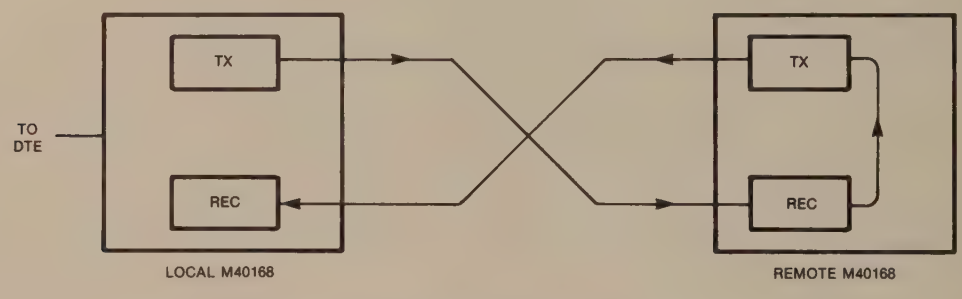



**Figure 4-6. Remote Modem Digital Loopback and Line Data Flow**

## 4.6 REMOTE MODEM ANALOG LINE LOOPBACK TEST

To start this test:

1. This test will be successful only if switch group S7, position 7 is OFF at the remote modem.
2. Press the AL switch on the remote modem until it engages. This commands the remote modem to loop the telephone line back to the local modem.
3. Press the TP switch on the local modem.
4. Observe the **RD** indicator. If **RD** is FLASHING, errors are being received; if **RD** is OFF, the operation is error-free.

**NOTE:** The remote AL switch connects two voice frequency lines (TX, RX) in series. It is possible that the combined lengths of the transmission pads will make that circuit unable to meet the line requirements for a 3002 circuit. If the local modem will not train (SQ ON for 20 seconds), try using the fallback speed. If the modem still will not train, presume the trouble is in the telephone line. If the modem does train, revert to normal speed and continue testing.

To end this test:

1. Release the AL switch at the remote modem.
2. Release the TP switch at the local modem.

See figure 4-7 for the analog line loopback data flow.

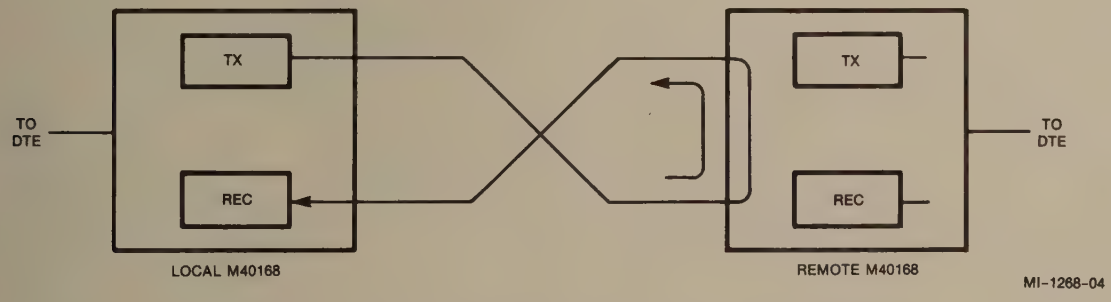



**Figure 4-7. Remote Modem Analog Line Loopback Data Flow**

## 4.7 FULL-DUPLEX LINE TEST

The following test will aid you in determining which side of the telephone line is defective. This test requires operator intervention at the Remote Site and should be used only after AL tests have been used to prove the integrity of the modems.

To start this test:

1. At the local modem, press the TP switch.
2. At the remote modem, press the TP switch.
3. Observe the **RD** indicator. If the **RD** stays ON or continues to FLASH, a fault in the receive data path for that modem is indicated.

To end this test:

1. At the remote modem, release the TP switch.
2. At the local modem, release the TP switch.

See figure 4-8 for the full-duplex line data flow.

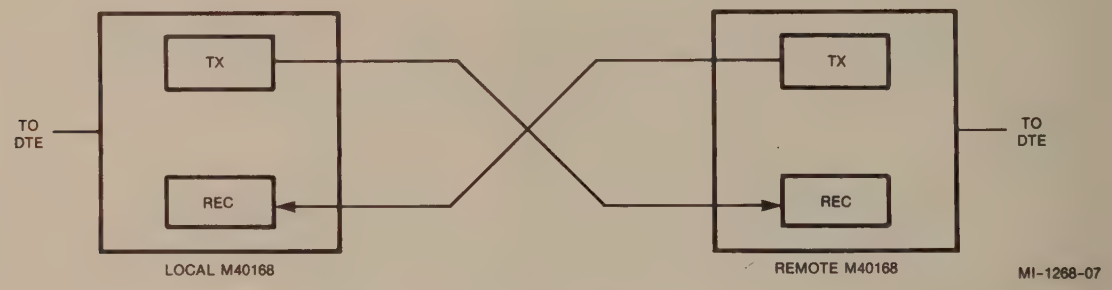



**Figure 4-8. Full-Duplex Line Data Flow**

# APPENDIX A

## TECHNICAL SPECIFICATIONS

*Clear-To-Send Delay*

0 or 15 ms is user-selectable for 4-wire, point-to-point constant carrier operation.

*Equalization*

Automatic adaptive equalizer
Equalization time:

TCM Mode: 500 ms at 16,800 bps
400 ms at 14,400 bps
300 ms at 12,000 bps
200 ms at 9600 bps

CCITT V.29 Modes: 253 ms at 9600 bps
50 ms at 4800 bps

*External Transmit Clock Timing Tolerance*

±0.01% of the operating data rates or better

*Indicators*

**48** 4800 bps data rate
**96** 9600 bps data rate
**12** 12,000 bps data rate
**14** 14,400 bps data rate
**16** 16,800 bps data rate
**SQ** Signal Quality
**RD** Received Data
**CD** Carrier Detect
**TD** Transmitted Data
**CS** Clear-To-Send
**RS** Request-To-Send

*Line Interface*

600 ohms impedance, balanced, transient protected

*Line Requirement*

4-wire leased, point-to-point, D1 conditioned. In the USA and Canada, AT&T Type 3002 channel or equivalent. In other countries, M1040 or equivalent.

| | |
|---|---|
| *Loopback Tests* | Digital Loopback loops the received data at the modem's digital (terminal) interface back to the line; and loops the terminal's transmitted data back to the terminal.<br><br>Remote Digital Loopback loops the received data at the remote modem's digital (terminal) interface back to the line. Remote DTE EIA signals are terminated.<br><br>Analog Loopback loops the transmitted data at the analog (telephone line) interface back to the terminal; or loops data received over the line back to the remote terminal.<br><br>Test Pattern generates a psuedo-random data pattern and activates a pattern detector for use with loopback tests. |
| *Modem Type* | Synchronous bit serial |
| *Modulation* | Quadrature Amplitude Modulation (Trellis Coding or CCITT V.29) |
| *Receiver Sensitivity* | −26 dBm ON, −31 dBm OFF or<br>−43 dBm ON, −48 dBm OFF; switch selectable<br><br>The OFF to ON threshold must be better than 2 dB above the ON to OFF threshold. |
| *Terminal Interface* | EIA RS-232-C and CCITT V.24/V.28 |
| *Transmission Speed* | 16,800, 14,400, 12,000, 9600, or 4800 bps; switch selectable |

# APPENDIX B

## PHYSICAL SPECIFICATIONS

| | |
|---|---|
| *Operating Environment* | 32 to 114 °F (0 to 45 °C), 0 to 95% relative humidity<br>USA — 117 ±10% V ac, 47 to 63 Hz, 15 watts<br>Export — 230 ±10% V ac, 47 to 63 Hz, 15 watts |
| *Size* | 13 ¾ inches (34.9 cm) wide<br>3 ½ inches ( 8.9 cm) high<br>18 inches (45.7 cm) deep<br>Shipping weight: 30 pounds (13.5 kg) |

# APPENDIX C

## MODEM-TO-DTE CONNECTOR PIN ASSIGNMENTS

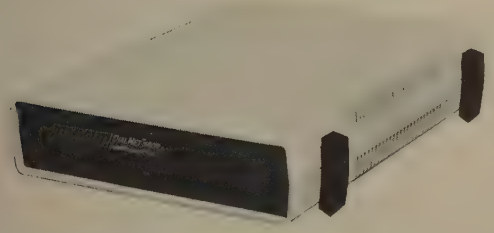
| Pin | EIA Circuit | MICOM Equivalent | Source | Description |
|---|---|---|---|---|
| 1 | AA | FG | . . . | Protective Ground |
| 2 | BA | TD | DTE | Transmitted Data |
| 3 | BB | RD | Modem | Received Data |
| 4 | CA | RTS | DTE | Request-To-Send |
| 5 | CB | CTS | Modem | Clear-To-Send |
| 6 | CC | DSR | Modem | Data Set Ready |
| 7 | AB | SG | . . . | Signal Ground |
| 8 | CF | CD | Modem | Data Carrier Detect |
| 9 | . . . | . . . | Modem | + Test Voltage |
| 10 | . . . | . . . | Modem | − Test Voltage |
| 11 | . . . | . . . | . . . | Not Connected |
| 12 | . . . | . . . | . . . | Not Connected |
| 13 | . . . | . . . | . . . | Not Connected |
| 14 | . . . | . . . | . . . | Not Connected |
| 15 | DB | TC | Modem | Transmit Clock |
| 16 | . . . | . . . | . . . | Not Connected |
| 17 | DD | RC | Modem | Receive Clock |
| 18 | CN | AL | DTE | Local Analog Loopback |
| 19 | . . . | . . . | . . . | Not Connected |
| 20 | . . . | . . . | . . . | Not Connected |
| 21 | . . . | . . . | . . . | Not Connected |
| 22 | . . . | . . . | . . . | Not Connected |
| 23 | CH | DRS | DTE | Data Rate Select |
| 24 | DA | ETC | DTE | External Transmit Clock |
| 25 | . . . | . . . | . . . | Not Connected |

# INTERESTED IN OTHER MICOM DATA COMMUNICATIONS PRODUCTS?

## Modems

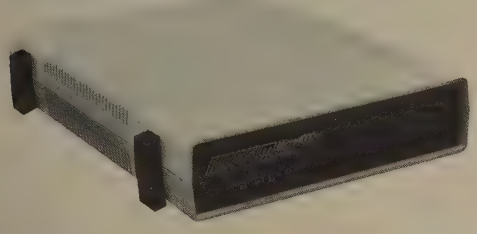
### 3000 • DIAL NETWORK COMMUNICATIONS

The DIALNET™3000 product line contains very attractively priced modems designed to transmit data effectively over the direct distance dial (DDD) network at speeds of 2400 or 1200 bps. Models are available that are compatible with CCITT V.22 *bis*, Bell 212, Bell 103, or Racal Vadic 3400. All models (except Models M3012TA and M3212TA, which operate in manual answer or auto-answer mode only) operate in a manual originate and an auto-answer mode and are offered in standalone or rack-mount versions. *Plus* series models add auto-dial features.



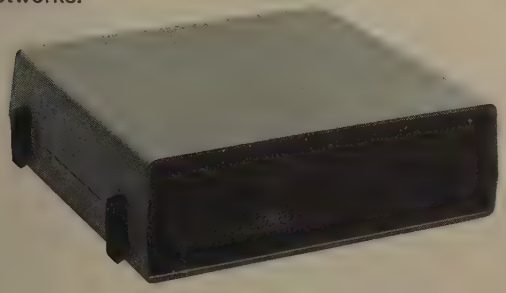
### 4000 • HIGH-SPEED COMMUNICATIONS

The Micro4000 Data Modem family is a series of inexpensive data modems operating at speeds from 2400 to 9600 bps. The modems conform fully to CCITT specifications and *all* models are suitable for both multipoint and point-to-point applications. Both 4800 and 9600 bps models feature a *speedshift* fast poll operation. A unique *asynchronous* 2400 bps modem is offered for use with teletype-compatible, "dumb" CRT and printing terminals.



### 8000 • MULTI-TERMINAL COMMUNICATIONS

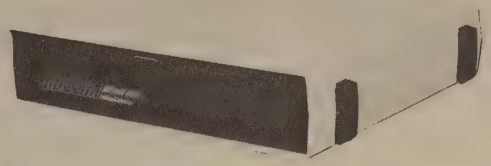
The Micro8000 Concentrator Modem is the world's first high-speed modem series with built-in data concentrator and automatic retransmission-on-error. The model range supports from 2 to 16 asynchronous or synchronous terminals and operates at speeds of 2400, 4800, and 9600 bps point-to-point or multipoint, over any standard telephone line. Concentrator PAD models are also offered for access to Packet Data Networks.



## Protocol Conversion

### 7400 • IBM 3270 EMULATION

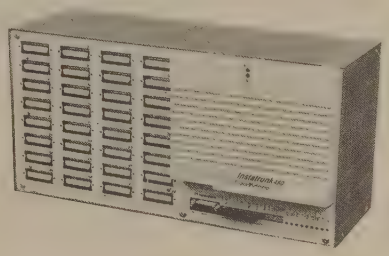
MICOM's Micro7400 is a low-cost substitute for IBM's 3274 Model 61C terminal controller that allows *asynchronous* terminals, printers, teleprinters, and personal computers to be used as IBM 3270-type terminals. The Micro7400 provides asynchronous terminal users with a *gateway* into IBM and provides IBM users with a means of accessing asynchronous devices.



## Multiplexing

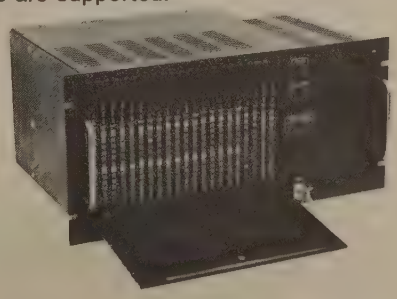
### 480 • LOCAL MULTIPLEXOR

MICOM's INSTATRUNK™480 T1 Local Multiplexor is a time-division multiplexor with a 1.544 Mpbs bandwidth—which allows it to carry *up to 128 channels, each of which can operate at up to 9600 bps.* Its signal can be transmitted over two twisted wire pairs for a distance of more than 1 mile. And, since the INSTATRUNK multiplexor uses standard T1 format, its signal can also be carried over longer distances by T1 repeaters, microwave links, or telephone company lines.



### 750 • WIDEBAND MULTIPLEXING

The Micro750 Wideband Multiplexor is a time-division multiplexor (TDM) designed to derive multiple synchronous channels from a single wideband circuit operating at 40.8, 48, 50, 72, or 256 kbps—or a DDS circuit operating at 56 kbps. The Micro750 can also be used to provide speed conversion between 50 and 56 kbps—or any other two wideband rates. EIA RS-232-C (CCITT V.24/V.28), CCITT V.35, Bell 303, CCITT V.11, and EIA RS-449 high-speed composite interfaces are supported.



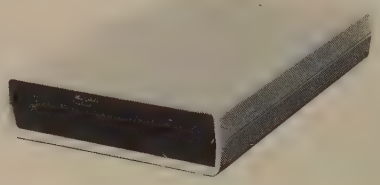
# Network and Switching

### 600 • DATA SWITCHING

The Micro600 Port Selector is a data PABX, providing switching capabilities of contention and port selection for up to 1504 asynchronous lines/ports. With its plug-in INSTAMUX and INSTATRUNK multiplexors and Micro800/2 concentrators plus its Interconnect Facility, the Micro600 is the heart of MICOM's INSTANET approach to local networking. (The Micro650 provides a similar capability for up to 126 *synchronous* lines/ports.)

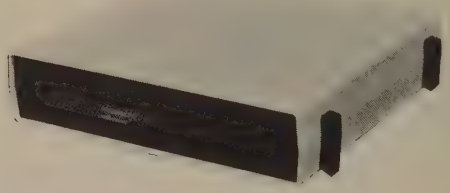
### 400 • SHORT-HAUL COMMUNICATIONS

The Micro400 Local Dataset family provides low-cost, full-duplex asynchronous or synchronous data transmission over distances up to 20 miles, point-to-point or multipoint. A special *smart* asynchronous model provides dial-up emulation for use with timesharing systems. All synchronous models can be connected directly to a Micro600 Port Selector quad module, providing a very low-cost solution for local data distribution applications. (For example, Model M400/600 is specifically designed for inexpensive terminal-controlled applications with the Micro600.) Local Dataset models are Bell 43401-compatible and operate over telephone company unloaded metallic circuits.



### 470 • SHORT-HAUL MULTIPLEXING

The INSTAMUX™470 is an extremely low cost *multiplexing line driver* which allows up to eight asynchronous terminals to communicate over two twisted pairs of wires at distances of up to 5000 feet. The INSTAMUX™470 is transparent to terminal code and speeds to 19,200 bps. MICOM also offers integral module versions of the INSTAMUX™470 for installation in the Micro600 Port Selector.



## Error Control

### 500 • ERROR-FREE COMMUNICATIONS

The Micro500 Error Controller eliminates transmission errors for teletype-compatible CRT and printing terminals and interactive graphics terminals communicating over telephone lines at speeds to 9600 bps. It also provides *asynchronous-to-synchronous* conversion allowing asynchronous terminals to operate with synchronous modems, and permits *full-duplex* asynchronous interactive terminals to operate with *half-duplex* synchronous modems at 2400 or 4800 bps on the dial network. MICOM offers an error controller with built-in modems (at 2400, 4800, or 9600 bps) called the Micro5000 Intelligent Modem.

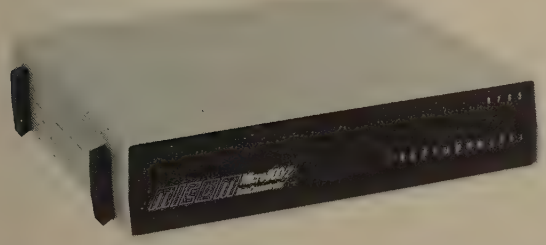
### 460 • DATA/VOICE MULTIPLEXING

The INSTALINK™460 Data/Voice Multiplexor allows simultaneous voice and data transmission utilizing *existing* in-plant telephone wiring. The INSTALINK™460 system consists of data/voice multiplexors at the users' telephones and a central chassis at the telephone PABX equipment room which connects to the user's computer or data PABX. INSTALINK™460 units operate at speeds up to 19,200 bps over distances up to 5000 feet and are *FCC Part 68 registered.*

# Data Concentration

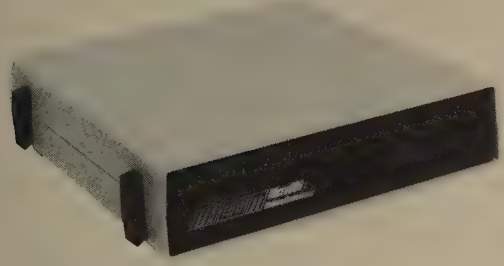
### 800/2 • STATISTICAL MULTIPLEXING

The Micro800/2 Data Concentrator is a low-cost second generation statistical multiplexor which allows up to sixteen terminals, both synchronous and asynchronous, to share a single telephone line. Retransmission-on-error between concentrators is automatic. Special low-cost models are offered for users of Hewlett-Packard HP 3000 computer systems. The Micro200 Port Concentrator, Model M220, allows Micro800/2 users to achieve additional system economics by reducing the number of computer ports required to support remote terminal clusters.



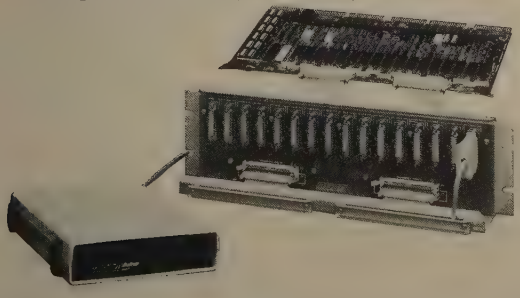
### 900 • MULTIDROP STATISTICAL MULTIPLEXING

The Micro900 Multidrop Concentrator permits up to 16 asynchronous, "dumb" terminals to share a single telephone line, multidropped in up to 16 separate locations. It allows multidropping of " dumb" terminals without polling software and provides automatic retransmission-on-error to ensure *error-free* communications.



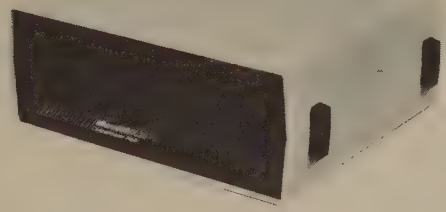
### 1011 • UNIBUS® MULTIPLEXING

The Series 11 BusDriver™ is *both* a DEC UNIBUS® replacement (for DH11™ or DZ11™ multiplexors) for local channel access *and* a port concentrator for remote data concentration. The BusDriver™ provides access into a PDP™-11 or VAX™ computer for up to 32 asynchronous terminals via a single HEX-size UNIBUS® module and is *fully* DEC-diagnostic compatible. A 16-connector panel provides access for local terminals and concentrated data streams. Options include expansion Remote Concentrator Controllers and integral 2400, 4800, or 9600 bps modems.



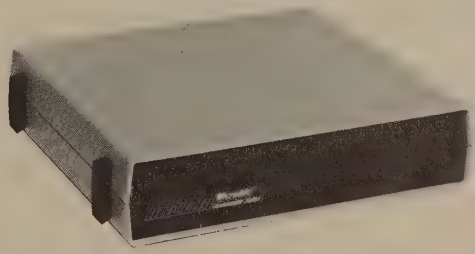
### 800/X.25 • PACKET ASSEMBLY/DISASSEMBLY

The Micro800/X.25 Concentrator PAD is an *extremely low-cost* Packet Assembler/Disassembler (PAD) Concentrator which provides asynchronous terminal concentration for Packet Data Networks by combining field-proven Micro800/2 features with CCITT Recommendations X.25, X.3, X.28, and X.29. Each unit has a Command Port for local terminal control; plus, optional Network Control Facility Software is offered for *centralized* management of a Micro800/X.25 PAD network.



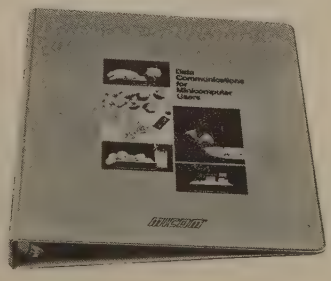
### 860 • CONCENTRATOR SWITCHING

The Micro860 Concentrator Switch is a low-cost *data concentrator switch* which interconnects up to eight Micro800/2 Data Concentators. The Micro860 operates as the hub of a network to allow any asynchronous channel on any of the data concentrators to connect with *any* channel on that or any other data concentrator. Standard Micro860 features include port switching, port contention, network command and log ports, and local switching.



## Micom Seminar on Data Communications

If you would like to learn more about the subject of data communications, MICOM organizes tutorial Seminars designed especially for the minicomputer user. The Seminars are offered nationwide throughout the year. Please call us to request a Seminar program and schedule. Act *now* to reserve your seat—space is limited.



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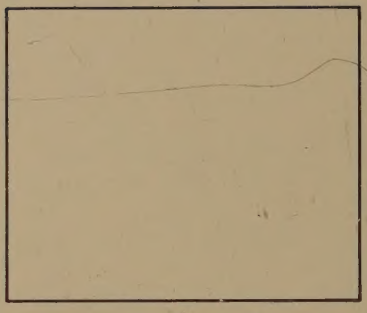

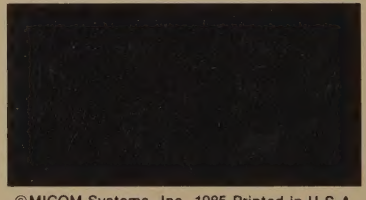

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